DyneSystems, Inc.

Midwest & Dynamatic Dynamometers

DS820-E

Power Amplifier Unit

USER MANUAL

Job # _____

Model # _____

Serial # _____

Configuration (amps)_____

Controller Configuration

- ☐ Inter-Loc V Control
- ☐ Dyn-Loc IV Control
- ☐ Customer-Supplied Control, 0-10 VDC

From Dyne Systems, Inc.

The DS820E Power Amplifier Unit (PAU) is a third generation, intelligent universal Eddy Current Power Amplifier Unit. It is an analog controller with a digital front end that offers greater flexibility for upgrading existing test cells, or for entirely new test installations. The potential applications for the PAU range from simple manual control to fully integrated closed loop installations. The PAU interfaces with all of Dyne Systems' existing dynamometer controllers, as well as industrial PC/PLC 24 VDC logic-based controllers running third party software.

The PAU provides a unique set of features:

- Set up is simple and straightforward.
- The front panel diagnostic LCD display eliminates guesswork by displaying real time field current, input command, status and fault messages.
- System status can also be reported via PLC level I/O to external controls.
- An analog voltage or current input enables the unit to be used as a standalone open loop eddy current power amplifier.
- It can be integrated into existing test cells with fully integrated closed loop control units.
- The modular construction of the PAU allows it to be interfaced with different dynamometer control components.

The PAU is available in wall mount or in a space saving and reduced wiring rack mount version. It also provides significantly increased current capabilities with ratings of 15, 30, 50 and 100 amps at up to 400 VDC. Higher non-standard current ratings can easily be custom engineered.

For customers who prefer to get leading edge performance and test cell system integration from a single provider, Dyne Systems' new PAU fully integrates with Dyne Systems' dynamometer controls and eddy current dynamometers.

NOTE: *This manual is intended for use by qualified personnel only. All Dyne Systems' approved drawings (if included) and specific instructions for this equipment must take precedence over general information contained in this manual.*

Thank you for purchasing this product from Dyne Systems. Our staff is at your disposal, should you need information or support that is not found in this manual.

DyneSystems, Inc.
Midwest & Dynamatic Dynamometers

CONTROLS, DYNAMOMETERS, SYSTEM INTEGRATION AND TEST CELL AUTOMATION

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SECTION 1: GENERAL INFORMATION

Within this manual, Dyne Systems, Inc. will be referred to as "DS".

SAFETY

Read your instruction manual! Electrical rotating equipment can be dangerous. Become familiar with all safety instructions and procedures. WARNING, CAUTION and NOTE labels are used throughout the manual to remind you of the hazards that exist. Know your equipment before handling or working on it.

Used to warn of the possibility of injury to personnel and damage to equipment

Used to caution of the potential hazards and unsafe practices

NOTE: *Used for special instructions related to safety, proper operation or maintenance*

RECEIVING INSPECTION

Upon the arrival of your equipment, check all items received against the packing slip to ensure the shipment is complete. Then inspect for damage. Any evidence of rough handling may be an indication of hidden damage. Be sure to perform the following inspections:

1. Inspect packaging and skid(s) for any mistreatment. Document and photograph any signs of damage.

2. Inspect housing to ensure there is no damage and that unit is intact.

DAMAGE CLAIMS

In the event of damage, report it without delay to the carrier and Dyne Systems. Dyne Systems' warranty policy does not cover shipping damage or lost material. It is important to file a damage claim with the carrier promptly. If you require assistance in settling the claim, contact Dyne Systems. Refer to equipment by purchase order, model, serial and job numbers, as shown on the nameplate of the unit involved.

TRAINING

Training programs are an essential part of safe and correct operation. Training provides the know-how necessary to obtain top performance from your equipment. Dyne Systems recognizes this fact and offers training classes on-site or at the factory to educate personnel in safe operating and maintenance procedures.

IDENTIFY YOUR PAU

This PAU was configured at DS for your specific application. The PAU will be physically configured as either wall mount or rack mount. Review the diagrams and verify your configuration:

Dyne Systems Inter-Loc V Control (see Figure 2.1 on Page 5).

Dyne Systems Dyn-Loc IV Control (see Figure 2.2 on Page 6).

Customer-Supplied Control: this requires 0-10VDC or 0-20mA Control Signal (see Figure 2.3 on Page 7).

Locate the model and serial numbers on the PAU and verify that they are the same as that shown on the cover of this manual. This information should be used when contacting DS customer support.

SECTION 2: CONFIGURATION

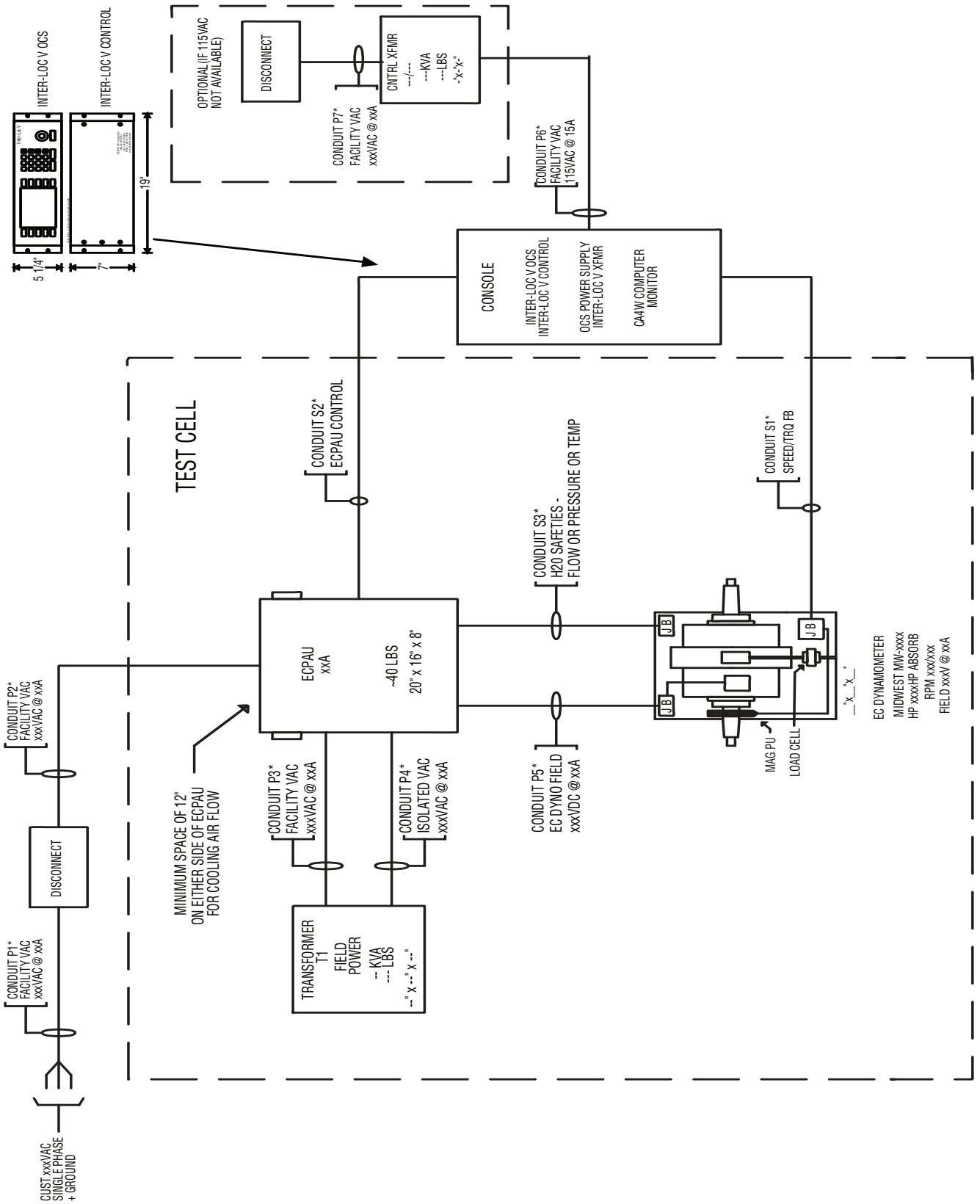
INTER-LOC V OCS
INTER-LOC V CONTROL
19"
5 1/4"
7"
OPTIONAL (IF 115VAC NOT AVAILABLE)
DISCONNECT
CONDUIT P7* FACILITY VAC xxxVAC @ xxA
CNTRL XFMR --/--- ---KVA ---LBS -"X-"X-"
CONDUIT P6* FACILITY VAC 115VAC @ 15A
CONSOLE
INTER-LOC V OCS
INTER-LOC V CONTROL
OCS POWER SUPPLY
INTER-LOC V XFMR
CA4W COMPUTER MONITOR
TEST CELL
CONDUIT S2* ECPAU CONTROL
CONDUIT S3* H2O SAFETIES - FLOW OR PRESSURE OR TEMP
CONDUIT S1* SPEED/TRQ FB
ECPAU xxA
~40 LBS 20" x 16" x 8"
J B
J B
J B
__"X__"X__
EC DYNAMOMETER
MIDWEST MW-xxxx
HP xxxHP ABSORB
RPM xx/xxx
FIELD xxV @ xxA
MAG PU
LOAD CELL
CONDUIT P2* FACILITY VAC xxxVAC @ xxA
DISCONNECT
CONDUIT P1* FACILITY VAC xxxVAC @ xxA
CUST xxxVAC SINGLE PHASE + GROUND
MINIMUM SPACE OF 12" ON EITHER SIDE OF ECPAU FOR COOLING AIR FLOW
CONDUIT P3* FACILITY VAC xxxVAC @ xxA
CONDUIT P4* ISOLATED VAC xxxVAC @ xxA
CONDUIT P5* EC DYNO FIELD xxxVDC @ xxA
TRANSFORMER T1 FIELD POWER -- KVA --- LBS -- "X --"X --"

Figure 2.1 - Inter-Loc V Controller Configuration with Wall Mount ECPAU (Optional Rack Mount)

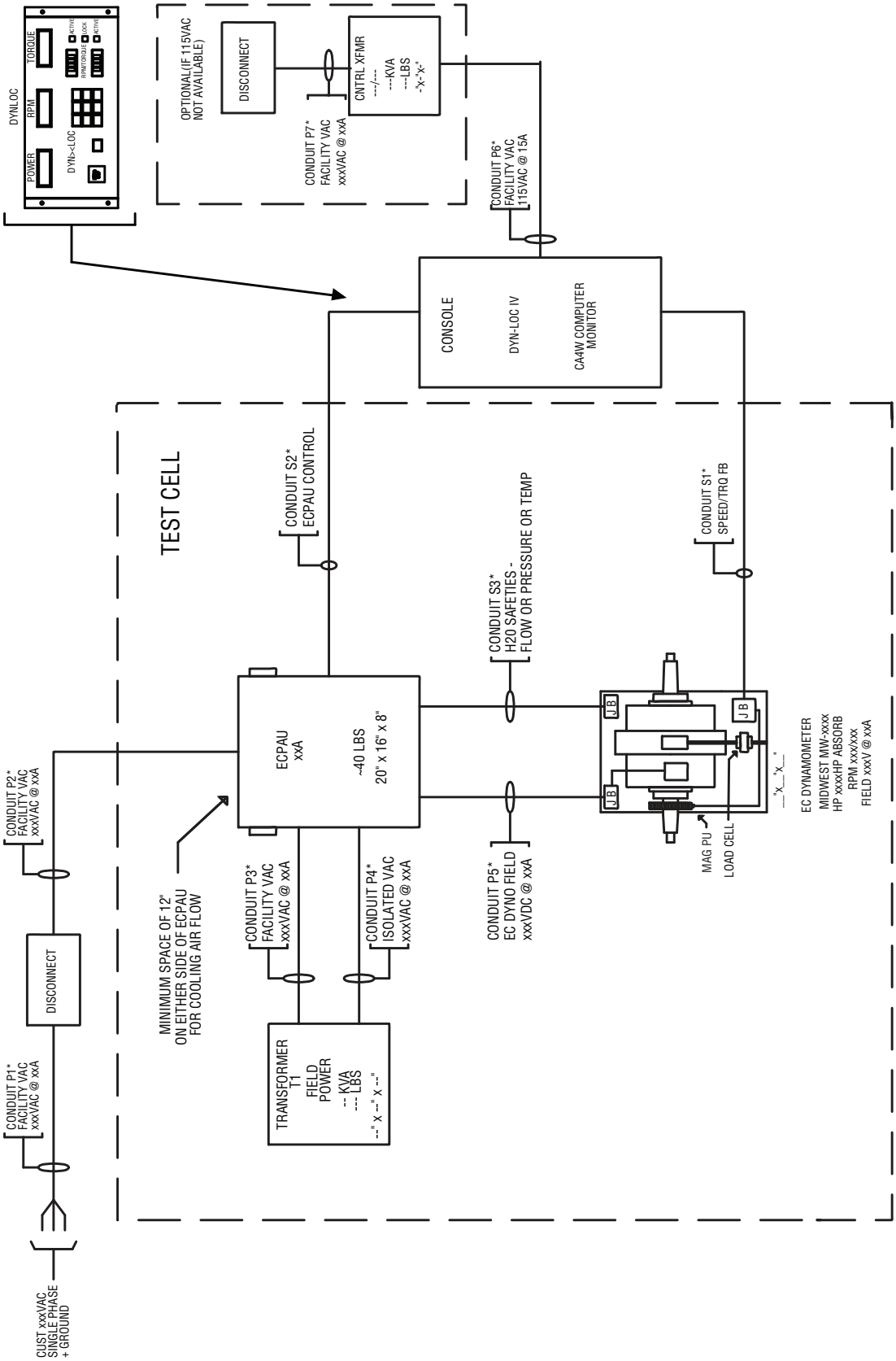
DYNLOC
TORQUE
RPM
POWER
DYN-LOC
OPTIONAL(IF 115VAC NOT AVAILABLE)
DISCONNECT
CONDUIT P7* FACILITY VAC xxxVAC @ xxA
CNTRL XFMR ---/--- ---KVA ---LBS -"X-"X-"
CONDUIT P6* FACILITY VAC 115VAC @ 15A
CONSOLE
DYN-LOC IV
CA44W COMPUTER MONITOR
TEST CELL
CONDUIT S2* ECPAU CONTROL
CONDUIT S3* H20 SAFETIES - FLOW OR PRESSURE OR TEMP
CONDUIT S1* SPEED/TRQ FB
ECPAU xxA
~40 LBS 20" x 16" x 8"
J B
J B
J B
__"X__"X__"
EC DYNAMOMETER
MIDWEST MW-xxxx
HP xxxHP ABSORB
RPM xxx/xxx
FIELD xxxV @ xxA
MAG PU
LOAD CELL
CONDUIT P2* FACILITY VAC xxxVAC @ xxA
DISCONNECT
CONDUIT P1* FACILITY VAC xxxVAC @ xxA
CUST xxxVAC SINGLE PHASE + GROUND
MINIMUM SPACE OF 12" ON EITHER SIDE OF ECPAU FOR COOLING AIR FLOW
CONDUIT P3* FACILITY VAC xxxVAC @ xxA
CONDUIT P4* ISOLATED VAC xxxVAC @ xxA
TRANSFORMER T1 FIELD POWER -- KVA --- LBS --" X --" X --"
CONDUIT P5* EC DYNO FIELD xxxVDC @ xxA

Figure 2.2 - Dyn-Loc IV Controller Configuration with Wall Mount ECPAU (Optional Rack Mount)

CONFIGURATION (CONTINUED)

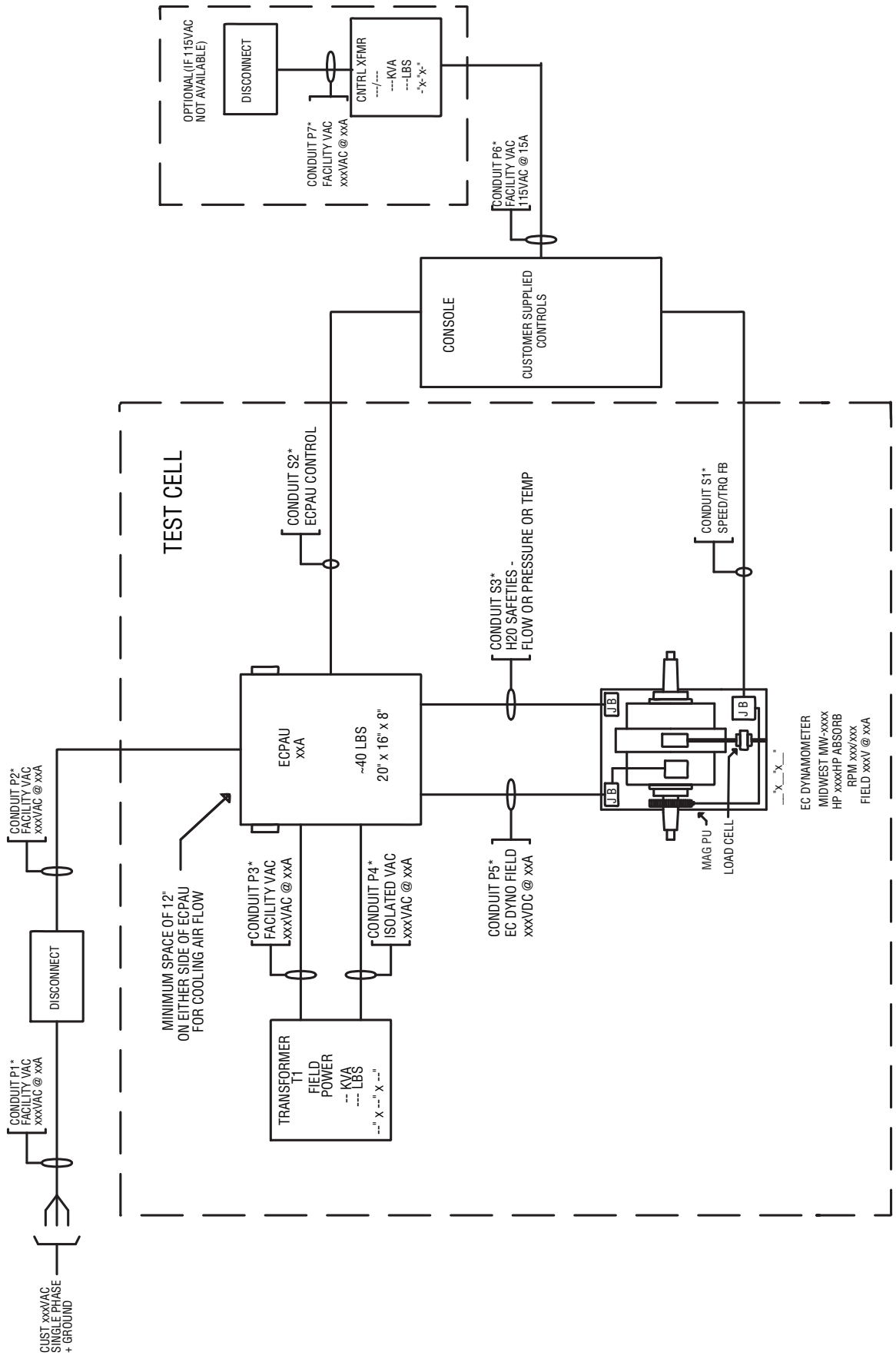
OPTIONAL (IF 115VAC NOT AVAILABLE)
DISCONNECT
CONDUIT P7* FACILITY VAC xxxVAC @ xxA
CNTRL XFMR ---/--- ---KVA ---LBS -"x-"x-"
CONDUIT P6* FACILITY VAC 115VAC @ 15A
CONSOLE
CUSTOMER SUPPLIED CONTROLS
TEST CELL
CONDUIT S2* ECPAU CONTROL
CONDUIT S3* H20 SAFETIES - FLOW OR PRESSURE OR TEMP
CONDUIT S1* SPEED/TRQ FB
ECPAU xxA
~40 LBS 20" x 16" x 8"
J B
J B
J B
__"x__"x__"
EC DYNAMOMETER
MIDWEST MW-xxxx
HP xxxxHP ABSORB
RPM xxx/xxx
FIELD xxxV @ xxA
MAG PU
LOAD CELL
CONDUIT P2* FACILITY VAC xxxVAC @ xxA
DISCONNECT
CONDUIT P1* FACILITY VAC xxxVAC @ xxA
CUST xxxVAC SINGLE PHASE + GROUND
MINIMUM SPACE OF 12" ON EITHER SIDE OF ECPAU FOR COOLING AIR FLOW
CONDUIT P3* FACILITY VAC xxxVAC @ xxA
CONDUIT P4* ISOLATED VAC xxxVAC @ xxA
CONDUIT P5* EC DYNO FIELD xxxVDC @ xxA
TRANSFORMER T1 FIELD POWER -- KVA --- LBS --" x --" x --"

Figure 2.3 - Customer-Supplied Controller, 0-10 VDC or 0-20mA Control Signal with Wall Mount ECPAU (Optional Rack Mount)

MODES OF RESET OPERATION

The PAU has two modes of operation: Reset Required Mode and Automatic Reset Mode.

In the Reset Required Mode, the PAU will require a reset after the application of power or after a fault condition has occurred. This reset signal is generated by the dynamometer control system. During a reset condition, a +24 VDC signal is momentarily applied to TB1-6 on the wall mount version, or pin 15 of the 25-pin Dynamometer Control Connector on the rear of the rack mount version. Reset Required Mode is the default mode of operation when used in conjunction with an Inter-Loc V controller.

In the Automatic Reset Mode, no reset will be required at power up and the following fault conditions will self restore: *SCR OverTemp*, *Coolant OverTemp*, *Low Coolant Pressure*/*Flow*, *Current OverCmd* and *GP Input Fault X*. The Automatic Reset Mode is the default mode of operation when used in conjunction with a Dyn-Loc IV controller.

Exercise caution when using the PAU in the Automatic Reset Mode, as the PAU could unexpectedly apply power to the coil resulting in excessive heating and possible failure if proper cooling is not supplied.

When a customer-supplied control system is used, Dyne Systems will configure the PAU to the mode of choice. If the customer does not specify the mode of operation at the time of order, it will be set to the Reset Required Mode.

SECTION 3: INSTALLATION ENVIRONMENT

The PAU should be mounted so it is not exposed to severe shock and/or vibrations. If adverse conditions are anticipated, the PAU can be mounted using vibration-damping materials.

The atmosphere should be free of corrosive gases, vapors or particulates that could cause fire or explosion.

Relative humidity should be 0 to 95% non-condensing.

Temperature range should be 32 to 90° F (0 to 32.2° C).

SECTION 4: TRANSFORMER COMPATIBILITY

It is important that the PAU, the Dynamometer Coil, and the Transformer are compatible. The following tables can be used to check these components in your system.

Wall Mount PAU, Coil and Transformer Compatibility Table

PAU		Transformer				Coil
Wall Mount PAU Model No.	Current Specifications	Facility Power (Primary)	PAU Input Power (Secondary)	Calculated Transformer VA	Max. Volts DC Output	Max. Coil Current
UEC-PAU-15-W01	15 amp	208	240	3,600	200	15
	15 amp	208	277	4,155	250	15
UEC-PAU-15-W02	15 amp	240	240	3,600	200	15
	15 amp	240	277	4,155	250	15
UEC-PAU-15-W03	15 amp	480	240	3,600	200	15
	15 amp	480	277	4,155	250	15
UEC-PAU-15-W04	15 amp	208	480	7,200	400	15
UEC-PAU-15-W05	15 amp	240	480	7,200	400	15
UEC-PAU-15-W06	15 amp	480	480	7,200	400	15
UEC-PAU-30-W01	30 amp	208	240	7,200	200	30
UEC-PAU-30-W02	30 amp	240	240	7,200	200	30
	30 amp	480	480	14,400	400	30
UEC-PAU-30-W03	30 amp	208	277	8,310	250	30
UEC-PAU-30-W04	30 amp	240	277	8,310	250	30
UEC-PAU-30-W05	30 amp	480	240	7,200	200	30
UEC-PAU-30-W06	30 amp	480	277	8,310	250	30
UEC-PAU-30-W07	30 amp	208	480	14,400	400	30
UEC-PAU-30-W08	30 amp	240	480	14,400	400	30
UEC-PAU-50-W01	50 amp	208	240	12,000	200	50
	50 amp	208	277	13,850	250	50
UEC-PAU-50-W02	50 amp	240	240	12,000	200	50
	50 amp	240	277	13,850	250	50
UEC-PAU-50-W03	50 amp	480	240	12,000	200	50
UEC-PAU-50-W03	50 amp	480	277	13,850	250	50
UEC-PAU-50-W04	50 amp	480	480	24,000	400	50
UEC-PAU-100-W01	100 amp	480	240	24,000	200	100

RACK MOUNT PAU, COIL AND TRANSFORMER COMPATIBILITY TABLE

PAU		Transformer				Coil
Rack Mount PAU Model No.	Current Specifications	Facility Power (Primary)	PAU Input Power (Secondary)	Calculated Transformer VA	Max. Volts DC Output	Max. Coil Current
UEC-PAU-15-R01	15 amp	208	240	3,600	200	15
	15 amp	208	277	4,155	250	15
	15 amp	240	240	3,600	200	15
	15 amp	240	277	4,155	250	15
UEC-PAU-30-R01	30 amp	208	240	7,200	200	30
	30 amp	208	277	8,310	250	30
	30 amp	240	240	7,200	200	30
	30 amp	240	277	8,310	250	30

SECTION 5: INSTALLATION AND START UP

WHO SHOULD INSTALL THE PAU

The DS820E PAU operates as part of a system. If the system is not properly wired, equipment may be damaged.

Only a qualified licensed electrician should install the DS820E PAU. *All installations should comply with the most current version of the National Electric Code (NEC) as well as all local codes.*

WALL MOUNT INSTALLATION

Enclosure Specifications

The Enclosure for the wall mount PAU meets the following industry standards: UL 50, File No.E27567 Type I; NEMA/EEMAC Type I; CSA, File No.42184 Type I; IEC 60529, IP30. The PAU enclosure does not meet oil-tight or dust tight specifications.

Dimensions

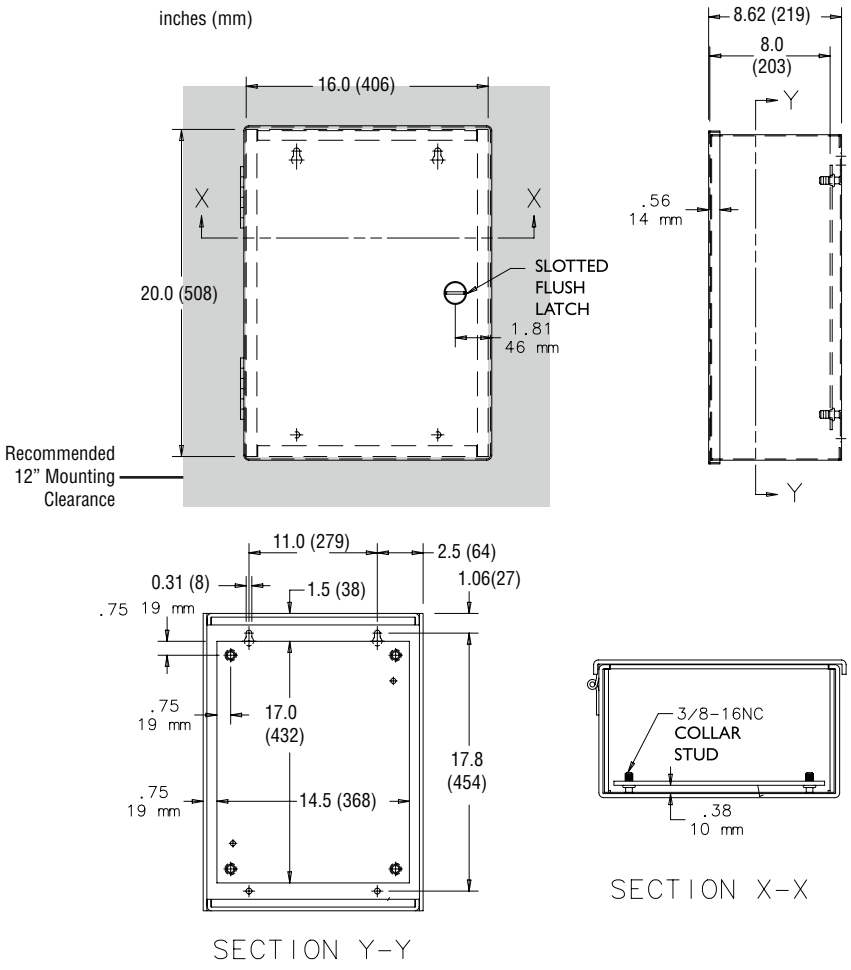

Figure 5.1 - Dimensions

Wall Mount Mechanical Installation

The PAU should be mounted in the vertical position (Refer to Figure 5.1). It is required that 12" of clearance around the entire PAU be provided to allow for filter changes and adequate airflow around the cabinet.

The method of mounting the PAU to a vertical surface is the responsibility of the end-user.

Wall Mount Wiring

Once the PAU is securely mounted, and all conduits with the appropriate wires are in place:

1. Open the access panel and route the wires into the panel.

2. Connect the wires according to the prints provided (Refer to Figure 5.2).

Note: *The prints provided with the PAU take priority over this manual.*

It is likely that not all of the terminal connections will be used.

The PAU has safety inputs in the form of Coolant Temperature and Coolant Pressure/ Flow. Additionally there are three spare generic safety inputs. These inputs have different functionality and correct wiring must be observed

Note: *All digital inputs to and outputs from the PAU terminals are PLC +24VDC logic. The Current Command (TB1-2 - TB1-3) is an analog signal of 0-10 VDC or 0-20mA. Both single ended and differential inputs can be configured. The Dyne On command is required to enable the controller; a dry contact wired between terminals TB1-4 and TB1-5 can be used in lieu of a PLC or controller.*

3. Close the access door and secure

Wall Mount Terminal Block Connections

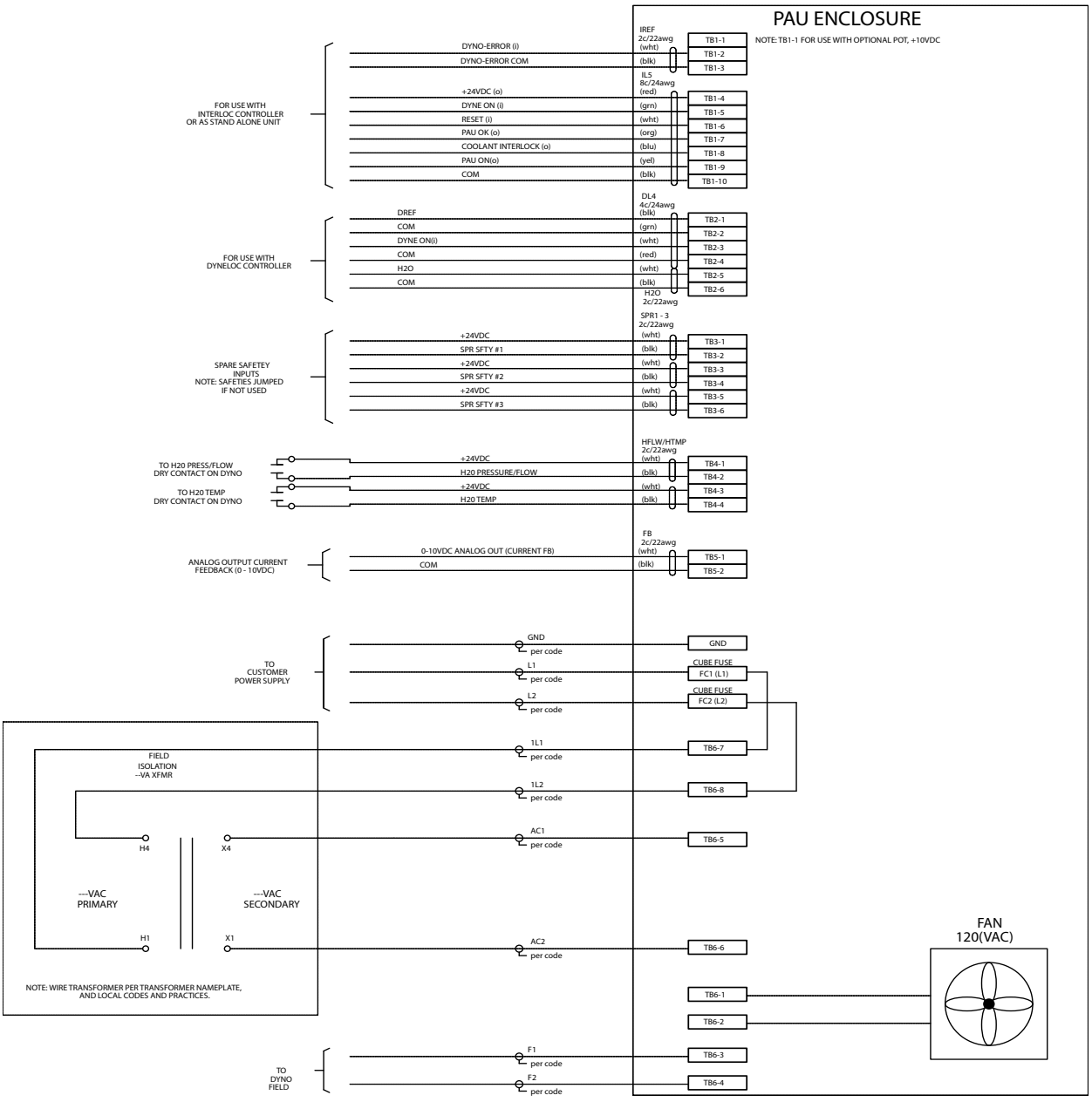

Figure 5.2 - Wall-Mount Terminal Block Connections

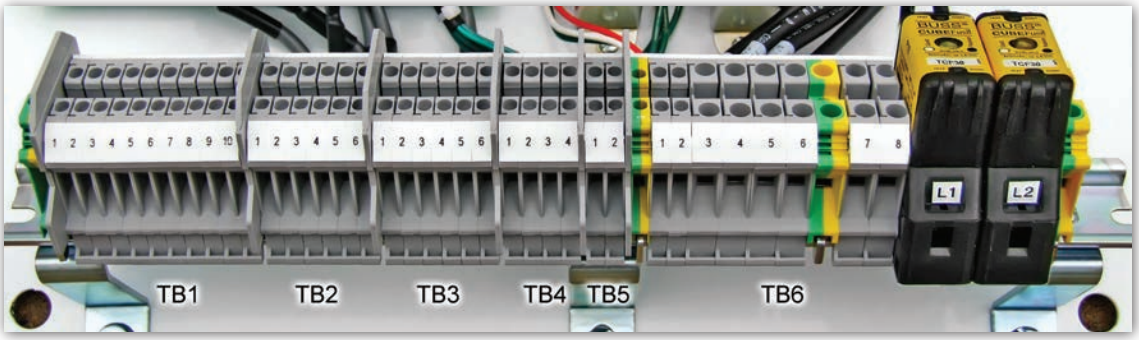

Figure 5.3 - Enlarged view of terminal block

Wall Mount Subpanel

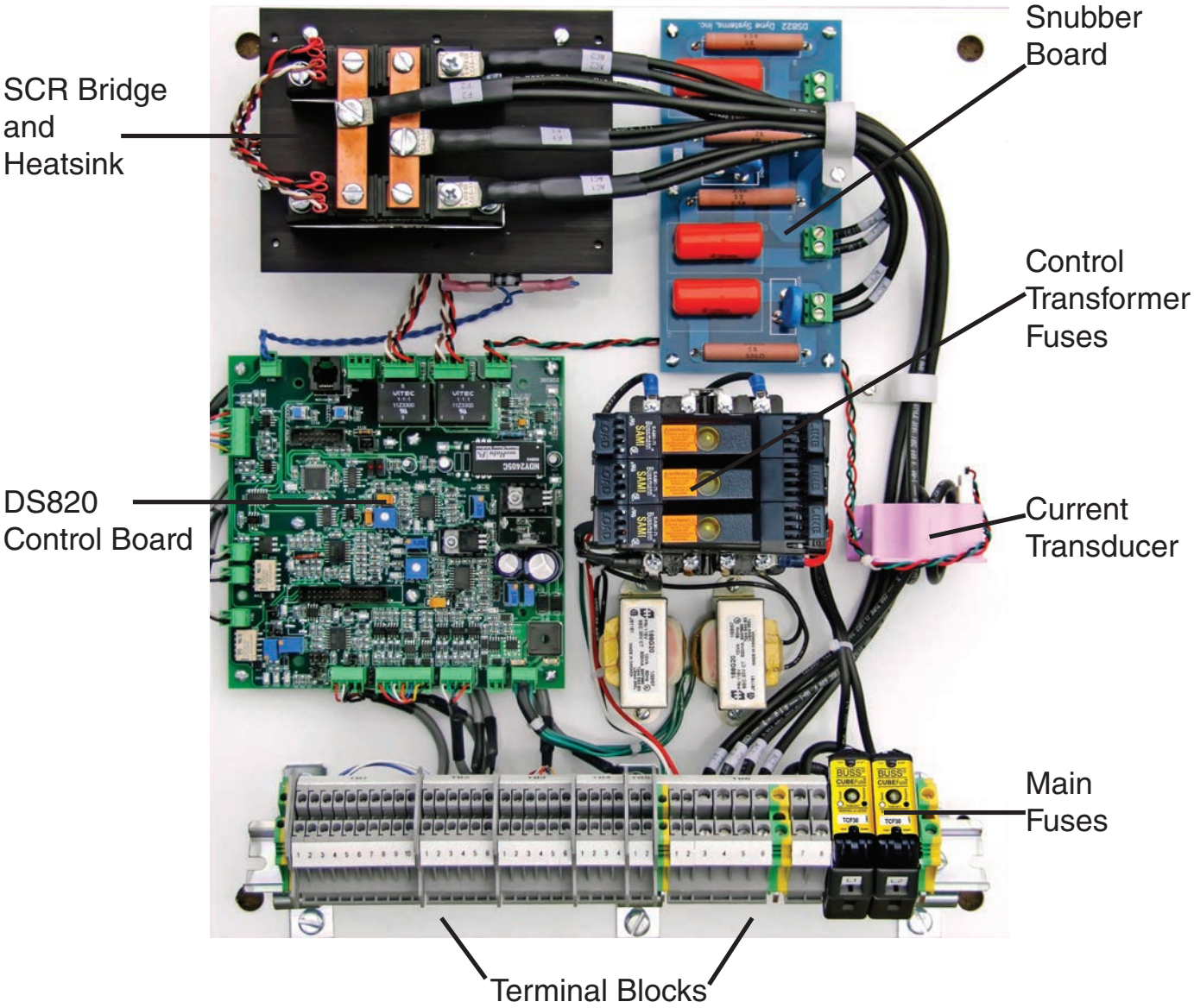

Figure 5.4 - Wall Mount Subpanel

WALL MOUNT START-UP

Inter-Loc V Start-Up

1. Validate that the configuration listed on the cover of the manual, exterior of the unit, and the sub-panel are identical and appropriate for your application. If these values do not match or are not appropriate for your application, please contact DS.

2. Verify the integrity of power wiring (i.e. no shorts to ground, verify coil resistance, etc).

3. Power up the Inter-Loc V / OCS.

4. Apply power to the PAU.

5. The following will appear on the display for ~3 seconds:

Eddy-Current	PAU
XX.X A max	VX.X

XX.XA - The maximum current of the PAU (15, 30, 50, 100)

VX.X - The version of firmware

The display will then change to the following:

Not Self Res.
Reset Required

Not Self Res. Reset Required - Requires a manual reset after the application of power or after a fault condition has occurred.

6. Push the RESET button on the OCS to initiate the system.

7. The following will appear on the display:

PAU:Ok	Off
0%	0.0A

PAU:Ok - Signifies everything is okay, or else the word *Fault* is displayed (refer to Wall Mount Signals Troubleshooting Guide on page 26).

Off - PAU is not enabled

% - Percentage of command signal 0-10 VDC or 0-20mA

A - Amount of current being applied to coil

If *Fault* is displayed, power down the Inter-Loc V and PAU, correct the fault, and then go back to Step 3.

8. Perform the Max Current adjustment if this is the first time use. (See Appendix A, p. 32 for setting Max Current.)

9. Your DS820E PAU is ready for use.

Dyn-Loc IV and Customer-Supplied Control Start-Up

When the PAU is powered up in the Automatic Reset Mode the dynamometer could power up in the same state it was in when power was turned off.

1. Validate that the configuration listed on the cover of the manual, exterior of the unit, and the sub-panel are identical and appropriate for your application. If these values do not match or are not appropriate for your application, please contact Dyne Systems.

2. Verify the integrity of power wiring (i.e. no shorts to ground, verify coil resistance, etc).

3. Power up the Dyn-Loc IV (or customer controls).

4. Apply power to the PAU. When power is applied a reset is not required. The following faults are self-restoring:

   - *SCR OverTemp*
   - *Coolant OverTemp*
   - *Coolant P/F*
   - *Current OverCmd*
   - *Spare Safeties*

   The following faults require the power to be turned off and the fault corrected before reapplying power:

   - *I Current Err*
   - *Current Reversed*
   - *No Field Current*

5. The following will appear on the display for ~3 seconds:

Eddy-Current	PAU
XX.X A max	VX.X

   XX.XA - The maximum current of the PAU (15, 30, 50, 100)

   VX.X - The version of firmware

6. The following will then appear on the display:

PAU:Ok	Off
0%	0.0A

   PAU:Ok - Signifies everything is okay, or else the word *Fault* is displayed (refer to Wall Mount Troubleshooting Guide on page 26).

   Off - PAU is not enabled

   % - Percentage of command signal 0-10VDC or 0-20mA

   A - Amount of current being applied to coil

   If *Fault* is displayed, power down the Dyn-Loc IV (or customer controls) and PAU, correct the fault and go back to Step 3.

7. Perform the Max Current adjustment if this is the first time use. (See Appendix A, p.32 for setting Max Current.)

8. Your DS820E PAU is ready for use.

RACK MOUNT INSTALLATION

Enclosure Specification

The DS820E PAU enclosure for the rack style PAU is designed for use in areas which do not require oil-tight and dust-tight applications. Fans are used to cool the interior. The intake is at the front of the unit.

Dimensions

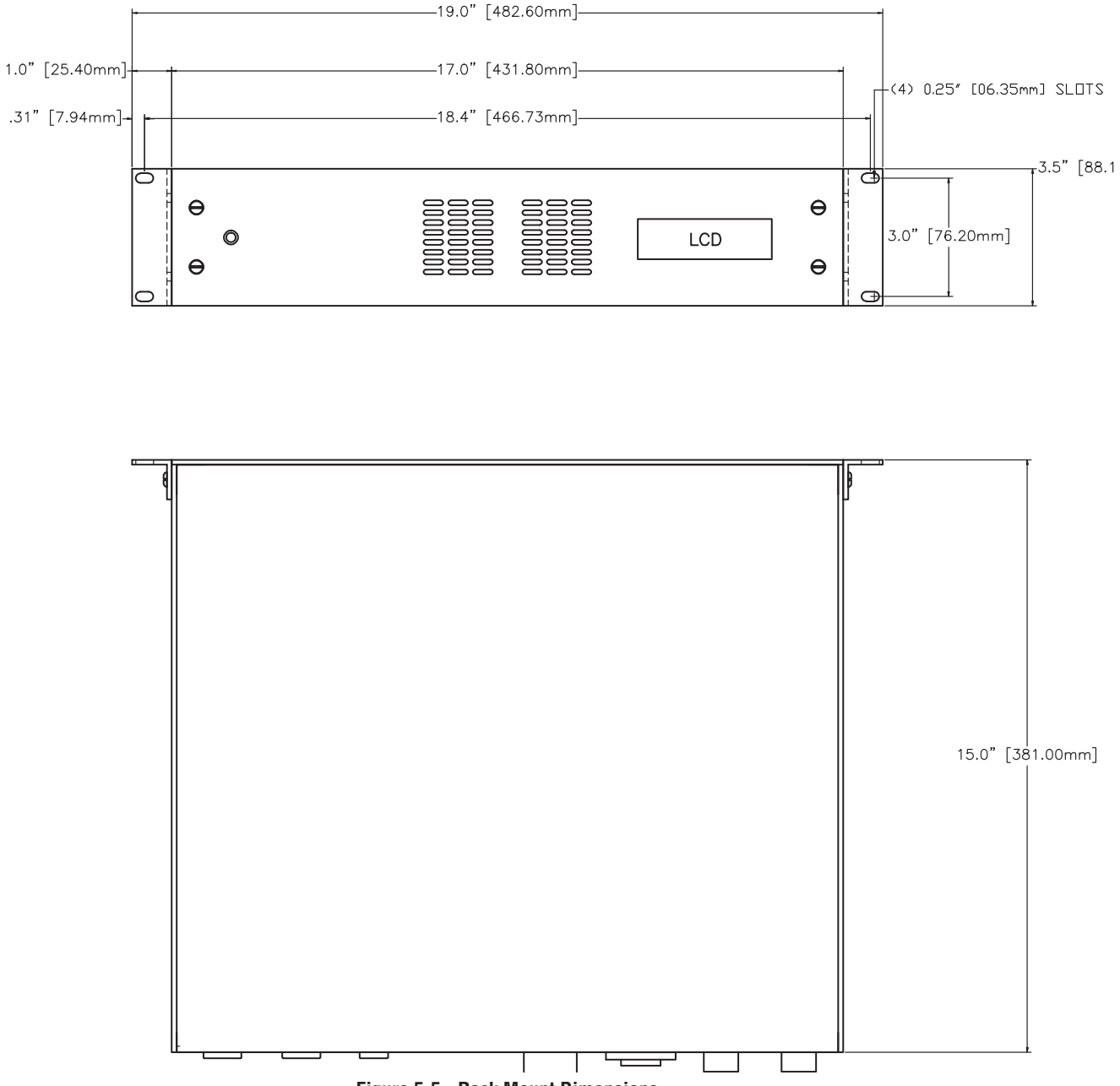

Figure 5.5 - Rack Mount Dimensions

Rack Mount Mechanical Installation

The PAU enclosure is designed to install in a standard 19 inch server rack using supplied rack mount brackets.

The method of securing the rack frame and mounting the PAU in the rack is the responsibility of the end user.

If access to the back of the unit is available the PAU shall be securely mounted before any connections are made.

1. Connect wires according to the 15 Amp wiring diagram (Figure 5.6) or 30 Amp wiring diagram (Figure 5.7).

2. When connections are secure, the PAU should be in position and mounted to the rack.

Rack Mount Wiring

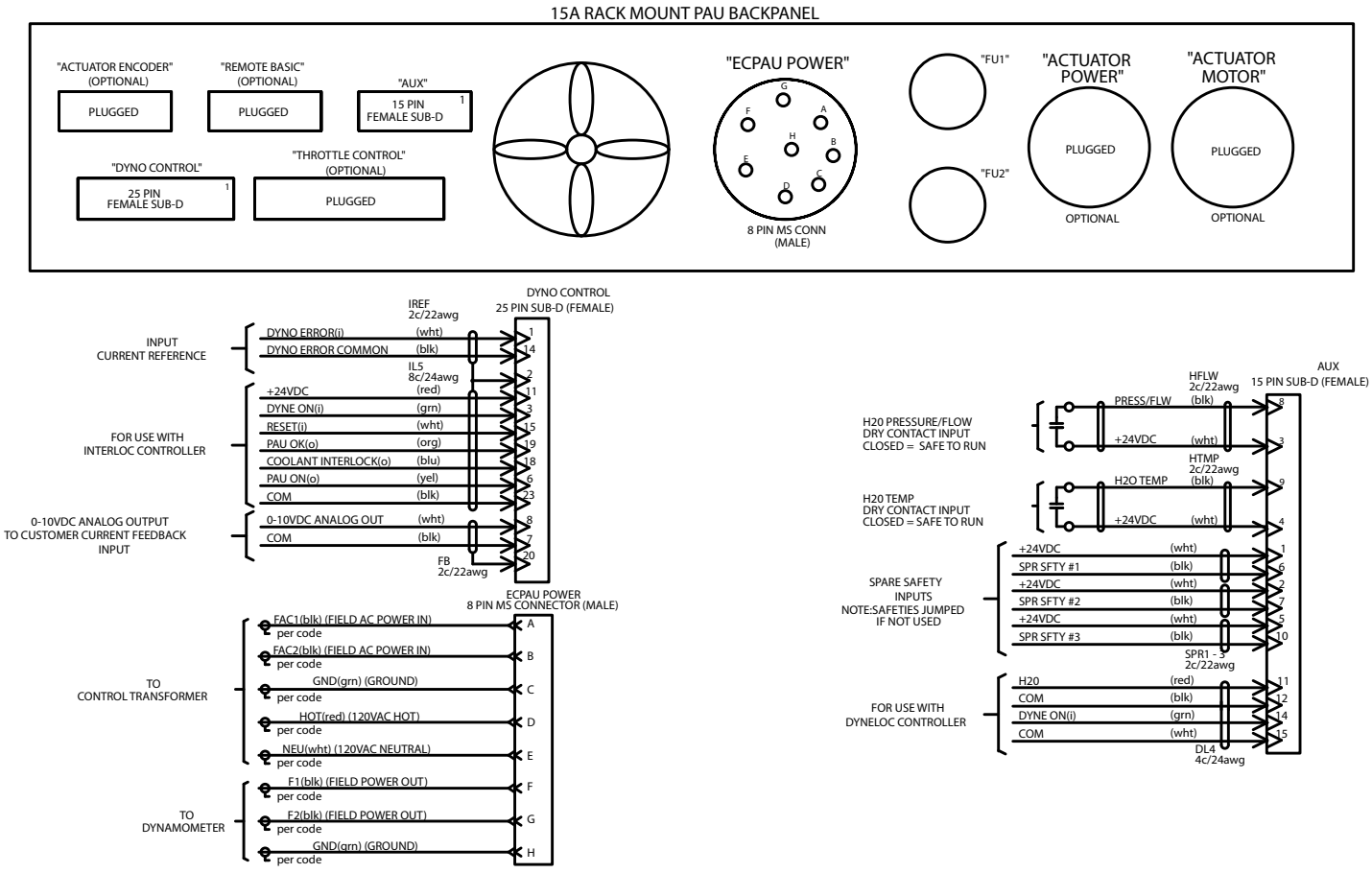

Figure 5.6 - 15 Amp Rack Mount PAU Back Panel Connections

RACK MOUNT WIRING (CONTINUED)

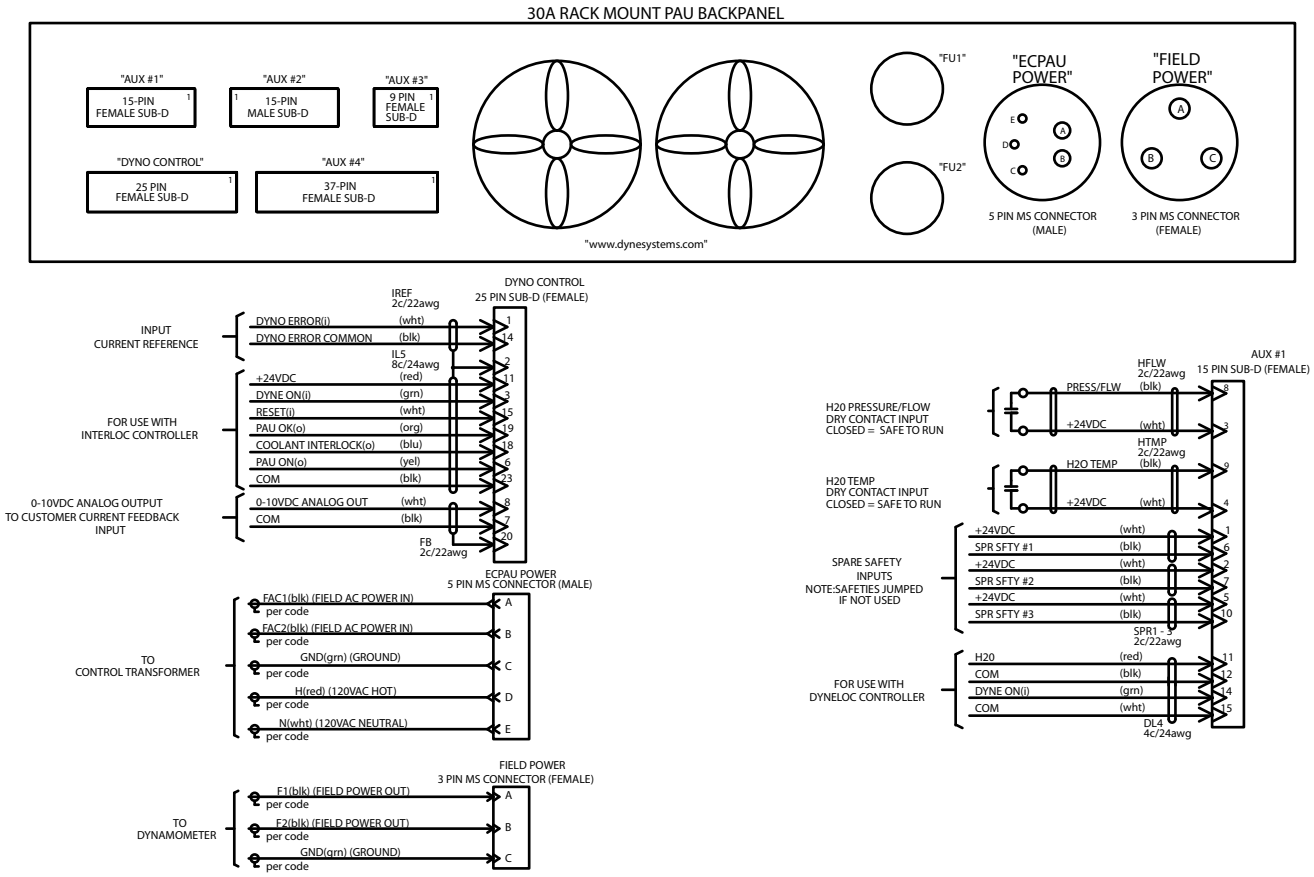

Figure 5.7 - 30 Amp Rack Mount PAU Back Panel Connections

RACK MOUNT START-UP

Inter-Loc V Start-Up

1. Validate the configuration listed on the cover of the manual and exterior of unit are identical and appropriate for your application. If these values do not match or are not appropriate for your application, please contact Dyne Systems.

2. Verify the integrity of power wiring (i.e. no shorts to ground, verify coil resistance, etc).

3. Power up the Inter-Loc V / OCS.

4. Apply power to the PAU.

5. The following will appear on the display for ~3 seconds:

Eddy-Current	PAU
XX.X A max	VX.X

XX.XA - The maximum current of the PAU (15, 30, 50, 100)

VX.X - The version of firmware

The display will then change to the following:

Not Self Res.
Reset Required

Not Self Res. Reset Required - Requires a manual reset after the application of power or after a fault condition has occurred.

6. Push the RESET button on the OCS to Initiate the System.

7. The following will appear on the display:

PAU: Ok	Off
0%	0.0A

PAU:Ok - signifies everything is okay, or else the word *Fault* is displayed (refer to Rack Mount Troubleshooting Guide on page 26).

Off - PAU is not enabled

% - Percentage of command signal 0-10VDC or 0-20mA

A - Amount of current being applied to coil

If *Fault* is displayed, power down the Inter-Loc V and PAU, correct the fault, and then go back to Step 3.

8. Perform the Max Current adjustment if this is the first time use. (See Appendix A, p.32 for setting Max Current.)

9. Your DS820E PAU is ready for use.

DYN-LOC IV AND CUSTOMER-SUPPLIED CONTROL START-UP

When the PAU is powered up in the Automatic Reset Mode, the dynamometer could power up in the same state it was in when power was turned off.

1. Validate the configuration listed on the cover of the manual and exterior of the unit are identical and appropriate for your application. If these values do not match or are not appropriate for your application, please contact Dyne Systems.

2. Verify the integrity of power wiring (i.e. no shorts to ground, verify coil resistance, etc).

3. Power up the Dyn-Loc IV (or customer control).

4. Apply power to the PAU. When power is applied a reset is not required. The following faults are self-restoring:

   - *SCR OverTemp*
   - *Coolant OverTemp*
   - *Coolant P/F*
   - *Current OverCmd*
   - *Spare Safeties*

   The following faults require the power to be turned off and the fault corrected before reapplying power:

   - *I Current Err*
   - *Current Reversed*
   - *No Field Current*

5. The following will appear on the display for ~3 seconds:

Eddy-Current	PAU
XX.X A max	VX.X

   XX.XA - The maximum current of the PAU (15, 30, 50, 100)

   VX.X - The version of firmware

6. The following will then appear on the display:

PAU:Ok	Off
0%	0.0A

   PAU:Ok - Signifies everything is okay, or else the word *Fault* is displayed (Refer to Rack Mount Troubleshooting Guide on page 26).

   Off - PAU is not enabled

   % - Percentage of command voltage 0-10VDC or 0-20mA

   A - Amount of current being applied to coil

   If *Fault* is displayed, power down the Dyn-Loc IV (or customer control) and PAU, correct the fault, and then go back to Step 3.

7. Perform the Max Current adjustment if this is the first time use. (See Appendix A, p.32 for setting Max Current.)

8. Your DS820E PAU is ready for use.

SECTION 6: PREVENTIVE MAINTENANCE

WALL MOUNT

The only maintenance items on the wall mount PAU are the cabinet air filter elements. It is recommended that the filter elements be removed, cleaned, and inspected every month. Use the following procedure to perform the routine maintenance:

1. De-energize all power source(s) prior to maintaining the filter assembly
2. Grasp the louvered cover and pull to snap open.
3. Remove filter element.
4. Wash with mild detergent and warm water.
5. Allow filter to air dry.
6. Insert clean filter element into the filter body.
7. Snap louvered cover into place.
8. Reapply power source(s).

RACK MOUNT

The only maintenance items on the rack mount PAU are the air vents and cooling fan(s). It is recommended that the air vents and cooling fans(s) be inspected **monthly** and any dust or debris be removed.

SECTION 7: APPLICATION SPECIFIC FUNCTIONALITY

Command Voltage Scaling

The command voltage input is typically a 0 to +10 VDC signal. Zero and span adjustments are available to accommodate non-standard input voltages. Use potentiometer P7 to zero and P8 to span the input command voltage while measuring at TP23(+) and TP20(-) for 0 and +10 VDC. Install JP12 to enable P7 if zeroing is needed.

Scaled Analog Output

Scaled Analog Output is an analog output voltage (0-10Vdc) representing dynamometer excitation current. This scaling represents a value from 0 to the ECPAU current limit as set by potentiometer P3 on the DS820E board. This signal is available at TB5 and also at the "Dyno Control" connector on the rack mount ECPAU version if JP13 is installed.

Dyn-Loc IV Interface

Using the DS820E PAU with a Dyne Systems Dyn-Loc IV controller requires some unique connections. TB2-1 thru TB2-6 on the wall mount unit and certain pins of the AUX connector on the rack mount are available for some of the Dyn-Loc IV specific signals. Jumper JP6 needs to be in POS B and the command input set for differential mode. This mode of operation is normally configured at the factory.

50Hz / 60Hz Operation

Jumper JP14 allows the DS820E to be configured for either 50Hz or 60Hz operation. **Do not move this jumper without first contacting Dyne Systems.**

Low Inductance Coil

Jumper JP2 should be installed when using a low inductance coil. Low inductance is indicated by a greater than 20% ripple on the dynamometer waveform (seen on oscilloscope).

Low Max Current

If the Dynamometer coil rating is less than 25% of the ECPAU rating, install JP7 before adjusting the current limit potentiometer P3. This ensures correct current regulation in the Dynamometer by the ECPAU.

0-20mA Command Source

Jumper JP1 allows use of a standard 0-20mA current command signal. Install JP1 to enable this option.

Additional Safeties

In addition to the two H_2O safeties (Coolant Temp and Coolant P/F) there are three inputs available for custom safeties or faults. TB3-1 thru TB3-6 provide connections for up to three dry contacts (closed = OK to run). Opening of these contacts will generate a fault. The LCD display will show "GP Input Fault 1, 2 or 3". This message can be customized at the factory if desired. The DS820E ships with jumpers in these inputs.

Note: *Reference Table 7.1 (next page) for all jumper definitions.*

DS820E Control Board Jumper Definitions

Jumper	Description	Default Positiion	Installed
JP1	OUT = Voltage input (0-10 VDC) IN = Current Input (0-20mA)	OUT	NO (Hanging)
JP2	Low Inductance Coil Jumper IN = Low Inductance Coil	OUT	NO (Hanging)
JP3	External Current Command Source = Rack Mount	OUT	NO (Hanging)
JP4	External Current Command Source = Wall Mount	IN	YES
JP5	External Armature Feedback from TB9	OUT	NO (Hanging)
JP6	IL5 / TB12 Dyne On Select POS A = IL5, POS B = TB12 (Isolated)	POS A	YES
JP7	Low “Max” Current Jumper	OUT	NO (Hanging)
JP8	Connects power commons	Hardwired	N/A
JP9	Connects power commons	Hardwired	N/A
JP10	Connects power commons	Hardwired	N/A
JP12	Input Voltage Offset IN = Allows P7 to Zero Input	OUT	NO (Hanging)
JP13	Scaled Analog Output Jumper (directs to Pin 8 of CON1)	OUT	NO (Hanging)
JP14	50 / 60Hz Select POS A = 60Hz, POS B = 50Hz	POS A	YES

Table 7.1

SECTION 8: FAULTS/TROUBLESHOOTING

Only qualified licensed electricians should open the PAU enclosure.

NOTE: *The Coolant Pressure/Flow safety input has a delay of ~5 seconds in the Reset Required Mode and is instant in the Automatic Reset Mode.*

NOTE: *The Coolant Temperature Safety input, along with the three Spare Safety inputs are instant in both Reset Modes.*

NOTE: *The main circuit board for the PAU has two LEDs (see Figure A.1, page 33 - DS820E Main Circuit Board). The LED toward the center of the board will pulse once each second. If the LED is not blinking the circuit board is defective or it is not getting power.*

Please refer to Table 8.1, Troubleshooting Guide (below).

Wall Mount and Rack Mount Troubleshooting Guide

Fault/Problem	Cause	Wall Mount Solution	Rack Mount Solution
No indication of Power. (LCD display blank, no red LED activity on DS820E logic board, fan not running).	No power from mains.	Verify integrity of Facility Mains	Verify integrity of Facility Mains
	Blown fuses.	Check PAU main fuses FC1, FC2	Check fuse FB1-2 (internal)
		Check PAU Control Transformer fuses (FU1, FU2, FU3).	
No output current from PAU.	PAU not enabled.	Ensure that there is an enable signal (+24 VDC) at TB1-5.	Ensure that there is an enable signal (+24 VDC) at Dyno Control pin 3.
	No current command signal.	Check that a 0-10 VDC or 0-20mA reference is being applied between TB1-2 (input) and TB1-3 (common).	Check that a 0-10 VDC or 0-20mA reference is being applied between Dyno Control pins 1 (input) and 14 (common)
SCR OverTemp fault showing in LCD display.	The SCR heat sink is too hot.	Allow time for the heat sink to cool down.	Allow time for the heat sink to cool down.
	Cooling fan not running.	Verify operation of cooling fan and its connections at TB6-1 and TB6-2.	Verify operation of cooling fan. Check fan fuse FB1-1 (internal).
	The heat sink temperature switch (NC) is defective or disconnected.	Verify the operation of the temperature switch mounted on the heat sink and its connections.	Verify the operation of the temperature switch mounted on the heat sink and its connections.
Coolant OverTemp fault showing in LCD display.	The dynamometer cooling system temperature has exceeded the setpoint of the coolant temperature switch (closed = safe to run).	Allow system to cool down. Verify the integrity of the coolant temperature switch and its connections to TB4-3 and TB4-4. If a temperature switch is not installed, a jumper should be installed across these terminals.	Allow system to cool down. Verify the integrity of the coolant temperature switch and its connections to AUX-4 and AUX-9. If a temperature switch is not installed, a jumper should be installed across these terminals.

Fault/Problem	Cause	Wall Mount Solution	Rack Mount Solution
Coolant P/F fault showing in LCD display.	The dynamometer cooling system pressure (or flow) has dropped below the setpoint of the coolant pressure (or flow) switch (closed = safe to run).	Verify the operation of the various components making up the dyno cooling system. Check functionality of coolant pressure (or flow) switch and its connections to TB4-1 and TB4-2. If a pressure (or flow) switch is not installed, a jumper should be installed across these terminals.	Verify the operation of the various components making up the dyno cooling system. Check functionality of coolant pressure (or flow) switch and its connections to AUX-3 and AUX-8. If a pressure (or flow) switch is not installed, a jumper should be installed across these terminals.
I Feedback Err fault showing in the LCD display.	The sensed current flow is different than the system expected.	If using a low inductance coil, try installing jumper JP2. Contact Dyne Systems.	If using a low inductance coil, try installing jumper JP2. Contact Dyne Systems.
Current Reversed fault showing in LCD display.	Current transducer wiring is incorrect.	Contact Dyne Systems	Contact Dyne Systems
No Field Current fault showing in LCD display.	Defective field coil, or wiring to the field coil.	Verify field coil integrity and its connections to the PAU at TB6-3 and TB6-4.	Verify field coil integrity and its connections to the PAU at appropriate connector (see Fig. 5.6 or Fig. 5.7).
	Main PAU fuses open.	Not Applicable	Check fuses (FU1, FU2).
	Defective field power transformer	Verify operation of field power transformer and its connections to TB6-5, TB6-6, TB6-7 and TB6-8.	Verify operation of field power transformer and its connections at appropriate connector (see 5.6 or Fig. 5.7).
Current OverCmd fault showing in LCD display.	The applied current command signal has exceeded 110%.	The nominal current reference range is 0 to 100%. Commanded currents of 101% are allowed indefinitely, 102% - 109% for approximately 10 seconds, 110% (or greater) are not allowed.	The nominal current reference range is 0 to 100%. Commanded currents of 101% are allowed indefinitely, 102% - 109% for approximately 10 seconds, 110% (or greater) are not allowed.

Table 8.1 - Wall and Rack Mount Troubleshooting Guide

Faults/Troubleshooting (Continued)

Wall Mount Signals

The PAU Wall Mount Unit uses hard wired terminal block connections to interface to the rest of the system.

Only qualified licensed electricians should open the PAU enclosure.

A qualified electrician can use the table below to monitor inputs/outputs to aid in diagnosing problems.

Terminal Connection	Description	Function
TB1-1	+10VDC	Output: +10VDC for Potentiometer option
TB1-2	Command Input	Input: 0-10VDC or 0-20mA command signal
TB1-3	Command Common	Input: Command common
TB1-4	+24VDC	Output: +24VDC for Dyne On and Reset
TB1-5	Dyne On	Input: Enables PAU
TB1-6	Reset	Input: Resets faults / errors
TB1-7	PAU OK	Output: PAU is okay (no faults exist)
TB1-8	P / F OK	Output: Coolant Pressure / Flow is okay
TB1-9	PAU On	Output: PAU is On
TB1-10	Common	Common for the +24VDC
TB2-1	Dyn-Loc Command Input	Input: Command signal form Dyn-Loc
TB2-2	Dyn-Loc Command Common	Input: Command common from Dyn-Loc
TB2-3	Dyn-Loc Dyne On	Input: Enables PAU
TB2-4	Dyn-Loc Dyne On Common	Input: Dyne On common
TB2-5	Dyn-Loc H_2O	Output: Dry contact for Dyn-Loc H_2O safety
TB2-6	Dyn-Loc H_2O	Output: Dry contact for Dyn-Loc H_2O safety

Terminal Connection	Description	Function
TB3-1	+24VDC	Output: +24VDC for Spare Safety 1
TB3-2	Spare Safety 1	Input: Spare Safety 1
TB3-3	+24VDC	Output: +24VDC for Spare Safety 2
TB3-4	Spare Safety 2	Input: Spare Safety 2
TB3-5	+24VDC	Output: +24VDC for Spare Safety 3
TB3-6	Spare Safety 3	Input: Spare Safety 3
TB4-1	+24VDC	Output: +24VDC for coolant pressure/flow switch
TB4-2	Coolant P/F	Input: Coolant pressure/flow switch
TB4-3	+24VDC	Output: +24VDC for coolant temperature switch
TB4-4	Coolant Temp	Input: Coolant temperature switch
TB5-1	Analog Out (+)	Output: Voltage proportional to coil current (0 - 10VDC)
TB5-2	Analog Out (-)	Output: Common
TB6-1	Cooling Fan	Output: 120VAC for cabinet cooling fan
TB6-2	Cooling Fan	Output: 120VAC for cabinet cooling fan
TB6-3	Field	Output: Connection to dynamometer coil
TB6-4	Field	Output: Connection to dynamometer coil
TB6-5	AC Input (from secondary)	Input: Connection from secondary side of transformer
TB6-6	AC Input (from secondary)	Input: Connection from secondary side of transformer
TB6-7	AC Output (to primary)	Output: Connection to primary side of transformer
TB6-8	AC Output (to primary)	Output: Connection to primary side of transformer
L1	Main AC Input	Input: Connection to facility main power
L2	Main AC Input	Input: Connection to facility main power
GND	Ground	Input: Connection to facility main ground

Table 8.2 - Faults / Troubleshooting, Wall Mount Signals

Note: *For further troubleshooting assistance, please contact Dyne Systems.*

Faults/Troubleshooting (Continued)

RACK MOUNT SIGNALS

The DS820E Rack Mount Unit uses D-SUB and MS type connections on the rear panel to interface to the rest of the system.

A qualified electrician can use the table below to monitor inputs / outputs to aid in diagnosing problems.

Terminal Connection		Description	Function
Dyno Control-1		Command Input	Input: 0-10 VDC or 0-20mA command signal
Dyno Control-14		Command Common	Input: Command signal common
Dyno Control-2		Command Cable Shield	Shield from Command Input Cable
Dyno Control-11		+24 VDC	Output: +24 VDC for Dyne On and Reset
Dyno Control-3		Dyne On	Input: Enables PAU
Dyno Control-15		Reset	Input: Resets faults / errors
Dyno Control-19		PAU OK	Output: PAU is okay (no faults)
Dyno Control-18		P / F OK	Output: Coolant pressure / flow is okay
Dyno Control-6		PAU On	Output: PAU is ON
Dyno Control-7		Analog Output Common	Output: Common for analog output
Dyno Control-8		Analog Output	Output: Voltage proportional to coil current (0-10VDC)
Dyno Contro-20		Analog Output Shield	Output: Shield for analog output
Dyno Control-23		Common	Common for the +24 VDC
15A	**30A**		
AUX-3	AUX1-3	+24VDC	Output: +24 VDC for coolant pressure / flow switch
AUX-8	AUX1-8	Coolant Pressure / Flow	Input: Coolant pressure / flow switch
AUX-4	AUX1-4	+24VDC	Output: +24VDC for coolant temperature switch
AUX-9	AUX1-9	Coolant Temp	Input: Coolant temperature switch
AUX-1	AUX1-1	+24VDC	Output: +24VDC for Spare Safety 1
AUX-6	AUX1-6	Spare Safety 1	Input: Spare Safety 1
AUX-2	AUX1-2	+24VDC	Output: +24VDC for Spare Safety 2
AUX-7	AUX1-7	Spare Safety 2	Input: Spare Safety 2
AUX-5	AUX1-5	+24VDC	Output: +24VDC for Spare Safety 3
AUX-10	AUX1-10	Spare Safety 3	Input: Spare Safety 3
AUX-11	AUX1-11	Dyn-Loc H_2O	Output: Dry contact for Dyn-Loc H_2O safety
AUX-12	AUX1-12	Dyn-Loc H_2O	Output: Dry contact for Dyn-Loc H_2O safety
AUX-14	AUX1-14	Dyn-Loc Dyne On	Input: Enable PAU
AUX-15	AUX1-15	Dyn-Loc Dyne On Common	Input: Dyne On common

Terminal Connection	Description	Function
Power Connections for 15A Rack Mount		
ECPAU Power-A	AC Input (Field Power)	Input: Connection from secondary side of transformer
ECPAU Power-B	AC Input (Field Power)	Input: Connection from secondary side of transformer
ECPAU Power-C	Ground	Ground connection for 120VAC
ECPAU Power-D	AC Input (120V Hot)	Input: Connection from secondary side of transformer
ECPAU Power-E	AC Input (120V Neutral)	Input: Connection from secondary side of transformer
Power Connections for 30A Rack Mount		
ECPAU Power-A	AC Input (Field Power)	Input: Connection from secondary side of transformer
ECPAU Power-B	AC Input (Field Power)	Input: Connection from secondary side of transformer
ECPAU Power-C	Ground	Ground connection for 120VAC
ECPAU Power-D	AC Input (120V Hot)	Input: Connection from secondary side of transformer
ECPAU Power-E	AC Input (120V Neutral)	Input: Connection from secondary side of transformer
Field Connections for 15A Rack Mount		
ECPAU Power-F	Field	Output: Connection to dynamometer coil
ECPAU Power-G	Field	Output: Connection to dynamometer coil
ECPAU Power-H	Ground	Ground connection to dynamometer coil
Field Connections for 30A Rack Mount		
Field Power-A	Field	Output: Connection to dynamometer coil
Field Power-B	Field	Output: Connection to dynamometer coil
Field Power-C	Ground	Ground connection to dynamometer coil

Table 8.3 - Faults / Troubleshooting, Rack Mount Signals

Note: *For further troubleshooting assistance, please contact Dyne Systems.*

SECTION 9: CUSTOMER SUPPORT

Dyne Systems Customer Support can be reached at 1-800-657-0726 or by Email at sales@dynesystems.com. Please have the serial and model numbers available for all products.

SECTION 10: PRODUCT WARRANTY

WARRANTY, REMEDIES AND LIMITATIONS: Dyne Systems, Inc. warrants the following equipment will conform to published specifications and be free from faulty material or workmanship for the listed time period from date of shipment or onsite repair:

New Controls	12 Months
Service Calls	3 Months
Repaired Controls	3 Months

This warranty covers properly installed equipment used within specified limits and ambient conditions and is limited to repair or replacement of equipment proving defective at Dyne Systems. For warranty to be valid, Buyer must conform to Dyne Systems' factory specifications. If applicable, terms of Warranty Validation and Delivery Certification must be met for warranty to be valid. This warranty does not apply to experimental, developmental or non-standards Goods and Products which are sold "as is", "where is". Dyne Systems shall not be liable for labor costs associated with removing, reinstalling or delivering any equipment. Transportation costs associated with delivering products to Dyne Systems under the warranty are the responsibility of the Buyer. Transportation costs associated with returning products to the Buyer under the warranty are the responsibility of Dyne Systems. If warranty service is deemed necessary and product (i.e. controls, small dynamometer, etc) can be shipped to Dyne Systems then it is expected that product be sent to Dyne Systems; however, if Buyer wants warranty work to be performed onsite and Dyne Systems deems it feasible then Buyer will be responsible for travel hours and travel / transportation costs. Dyne Systems is not liable for costs incurred such as loss of work time or production time or for loss of profits or other damages, including, but not limited to consequential damage.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND ARE GIVEN AND ACCEPTED IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE REMEDIES OF BUYER FOR ANY BREACH OF WARRANTY SHALL BE LIMITED TO THOSE PROVIDED HEREIN, AND FOR DELAY OR NON-DELIVERY WHICH IS NOT EXCUSABLE, TO THE PURCHASE PRICE OF THE GOODS IN RESPECT OF WHICH THE DELAY OR NON-DELIVERY IS CLAIMED, TO THE EXCLUSION OF ANY AND ALL OTHER REMEDIES. IN NO EVENT SHALL DYNE SYSTEMS BE LIABLE FOR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOSS OF USE OR PROFITS. NO AGREEMENT VARYING OR EXTENDING THE FOREGOING WARRANTIES, REMEDIES OR THIS LIMITATION WILL BE BINDING UPON DYNE SYSTEMS UNLESS IN WRITING SIGNED BY A DULY AUTHORIZED OFFICER OF DYNE SYSTEMS. DYNE SYSTEMS' LIABILITY FOR FAILURE TO COMPLY WITH ANY WARRANTY OR REPRESENTATION HEREUNDER SHALL BE LIMITED TO THE VALUE OF THE GOODS SOLD HEREUNDER.

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LIMITATION OF LIABILITY: Dyne Systems' liability for defective or nonconforming products, whether based on breach of warranty negligent manufacture or product liability, is exclusively limited to repair or replacement, at Dyne Systems' election, of such products. Dyne Systems assumes no risk and shall be subject to no liability for any damages or loss resulting from the specific use or application made of the Products. Dyne Systems' liability for any other claim, whether based on breach of contract, negligence or product liability, relating to the products shall not exceed the price paid by Buyer for such Products. In no event will Dyne Systems be liable for any special, incidental or consequential damages, including loss of use, loss of profit, claims of third parties, or damages arising from bodily injury, or death, however caused, whether by the negligence of Dyne Systems or otherwise.

EQUIPMENT MADE BY OTHERS: Any items supplied that are not manufactured by Dyne Systems are covered by the original manufacturer's warranty and not by a Dyne Systems warranty.

BUYER SUPPLIED PRODUCT: Dyne Systems accepts Buyer provided equipment as a courtesy only. Dyne Systems is not responsible for determining suitability of Buyer's equipment for a particular purpose. Repair or configuration of Buyer-supplied equipment will be charged at Dyne Systems normal rate.

APPENDIX A: PAU MAX CURRENT ADJUSTMENT

Only qualified personnel should adjust the PAU Field Current without assistance from Dyne Systems Personnel

Coolant must be flowing during this procedure

NOTE: *The dynamometer does not need to be spinning during this procedure.*

To ensure proper control of the dynamometer and, more importantly, to protect the coil from damage, the PAU needs to be adjusted to match the characteristics of the dynamometer coil. The DS820E PAU has a Max Current adjustment potentiometer (P3). Since dynamometer coil characteristics vary greatly depending on many factors, it is difficult to preset this adjustment at the factory. It is important that after all connections are made, the Max Current adjustment be performed.

When first powering on the PAU, the LCD splash screen shows a current value of 15, 30, 50, or 100 A. This displayed value represents the maximum current that the PAU is capable of delivering, it does not represent the actual setting of the current limit.

After enabling the PAU, the LCD display will show the field current that is being applied to the dynamometer. Use this value for making all adjustments.

PAU:Ok	Off
X%	X.XA

PAU:Ok - Signifies everything is okay, or else the word *Fault* is displayed (refer to Wall and Rack Mount Troubleshooting Guide, Table 8.1, page 26).

Off - PAU is not enabled

X% - Percentage of command signal (0% = 0VDC or 0mA; 100% = 10VDC or 20mA)

X.XA - Amount of current being applied to coil

The max current setting is preset at the factory to either the minimum setting or an approximate match to the dynamometer that was specified at the time of sale. In either case, use the following procedure to check or adjust the max current setting:

1. Power OFF the PAU.
2. Turn potentiometer P3 (Figure A-1) on the DS820E board fully counter-clockwise (minimum field current setting).
3. Ensure that the dynamometer coolant is flowing and all safeties are met or jumped out.

APPENDIX A: PAU MAX CURRENT ADJUSTMENT (CONTINUED)

4. Power ON the PAU.

5. Enable the PAU and apply 100% command signal set at +10.0VDC or 20mA.

6. While enabled, adjust P3 (Max Current Setting) until the desired coil current is reached (CCW lowers the coil current and CW increases the coil current). The new field current setting is displayed on the LCD display. Physically measure the coil current as a precaution. Make sure the measured current closely matches the LCD display.

7. Disable the PAU.

8. Connect a DMM to TP20 (black lead) and TP6 (red lead). Adjust P4 until you measure -0.050VDC (negative 50mV).

9. Max current setting is complete

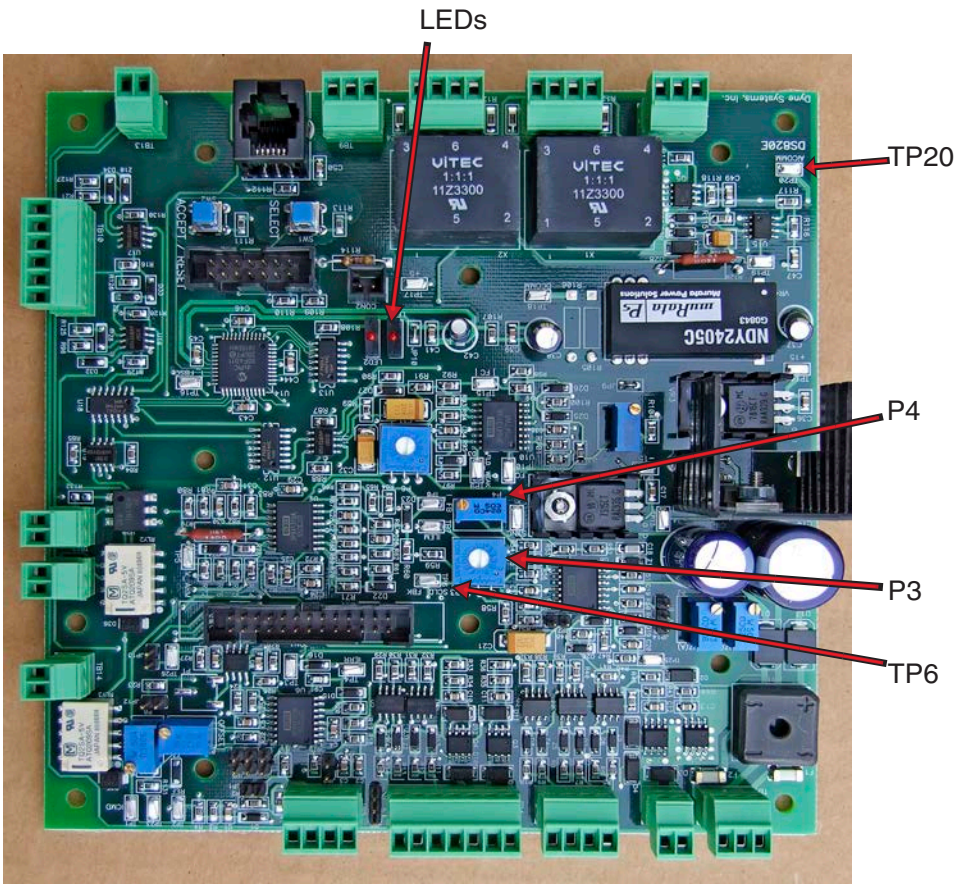

Figure A.1 - DS820E Main Circuit Board

APPENDIX B: OHM'S LAW

Ohm's Law defines the relationships between (P) power, (E) voltage, (I) current, and (R) resistance. One ohm is the resistance value through which one volt will maintain a current of one ampere.

I (Current) = P (Power) / E (Voltage)

I (Current) = E (Voltage) / R (Resistance)

(I) Current is what flows on a wire or conductor like water flowing down a river. Current flows from negative to positive on the surface of a conductor. Current is measured in (A) amperes or amps.

(E) Voltage is the difference in electrical potential between two points in a circuit. It's the push or pressure behind current flow through a circuit, and is measured in (V) volts.

(R) Resistance determines how much current will flow through a component. Resistors are used to control voltage and current levels. A very high resistance allows a small amount of current to flow. A very low resistance allows a large amount of current to flow. Resistance is measured in ohms.

(P) Power is the amount of current times the voltage level at a given point measured in wattage or watts.

APPENDIX C: DRAWINGS AND SCHEMATICS

RACK MOUNT CONNECTIONS - 15 AMP

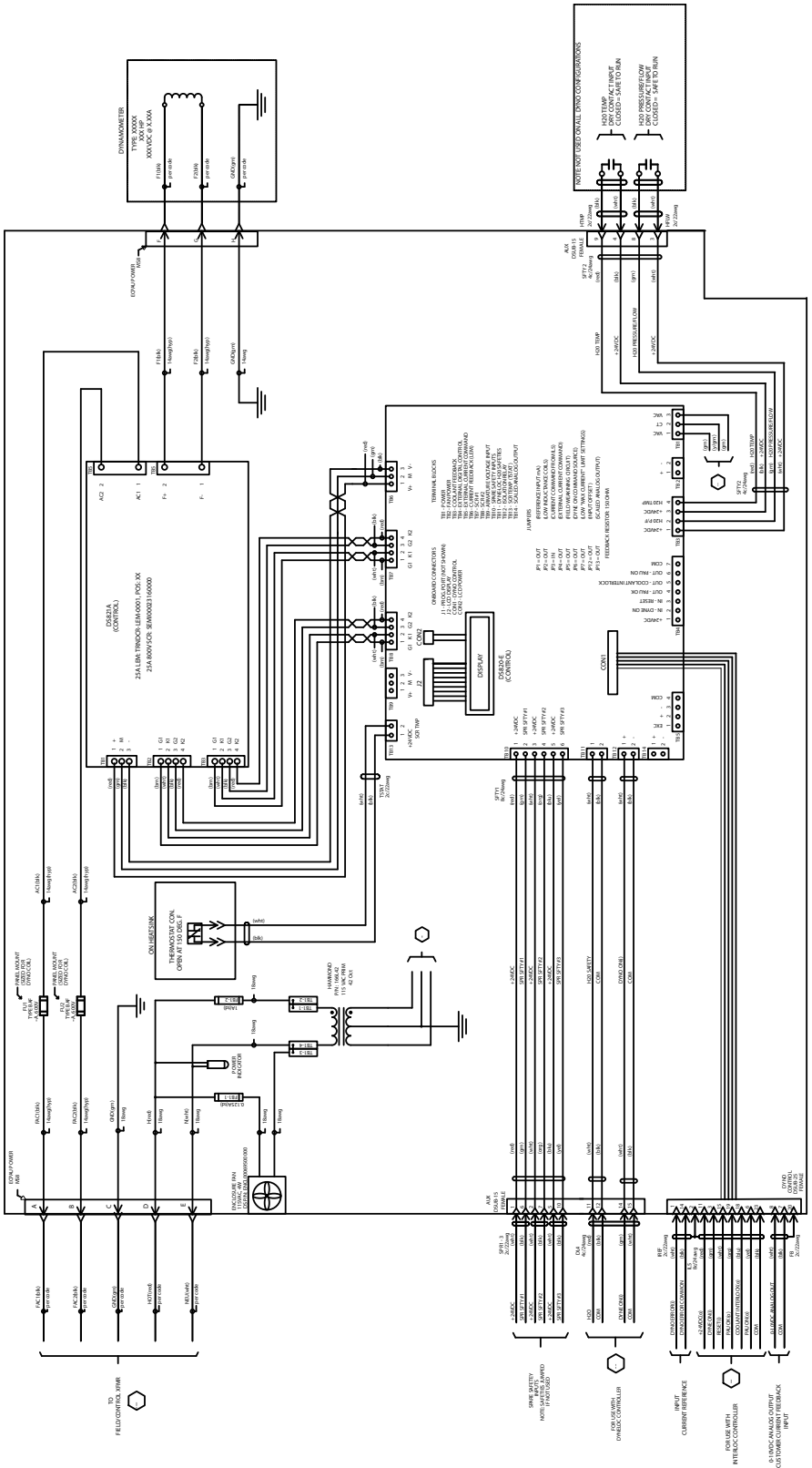

Figure C-1 - Rack Mount Connections, 15 Amp

RACK MOUNT CONNECTIONS - 30 AMP

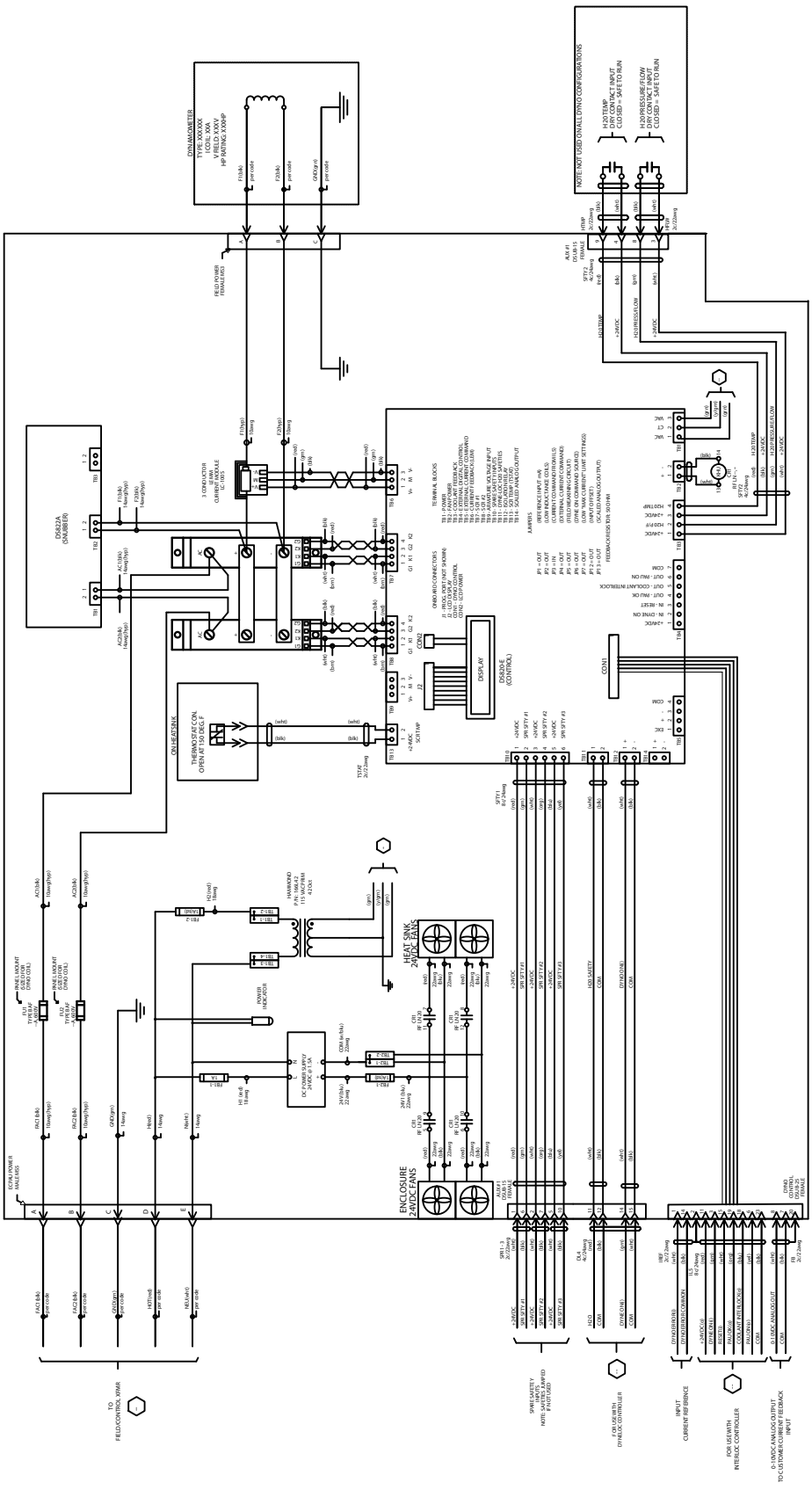

Figure C-2 - Rack Mount Connections, 30 AMP

WALL MOUNT SCHEMATIC

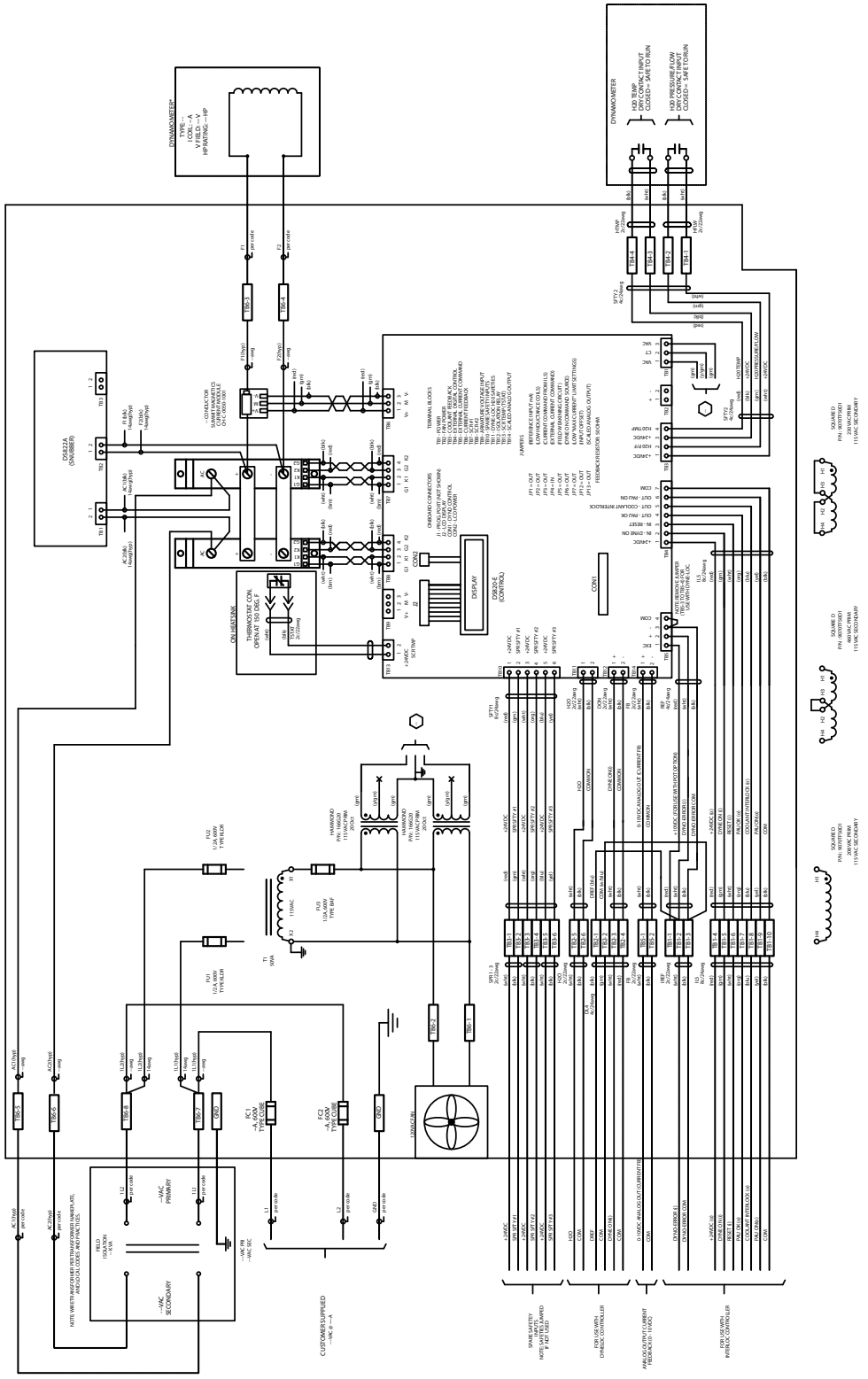

Figure C-3 - Wall Mount Schematic

APPENDIX D: ACRONYMS

A – Ampere

AC – Alternating Current

˚C – Degrees Centigrade

CSA – Canadian Standards Association

CW – Clockwise

CCW – Counter Clockwise

DC – Direct Current

DUT – Devices under Test

E – Voltage (Volts)

EEMAC – Electrical Equipment Manufacturers Association of Canada

˚F – Degrees Fahrenheit

FAC – Field AC Power

FU – Fuse

GND – Ground

HP – Horse Power

I – Current (Amps)

I/O – Input or Output

IEC – International Electrotechnical Commission

JB – Junction Box

KVA – Kilovolt-Ampere

KW – Kilowatt

LBS – Pounds

LCD – Liquid Crystal Display

LED – Light Emitting Diode

NC – Normally Closed Contact

NEC – National Electric Code

NEMA – National Electrical Manufacturers Association

NO – Normally Open Contact

OCS – Operator Control Station

P – Power (Watts)

PAU – Power Amplifier Unit

PC – Personal Computer

R – Resistance (Ohms)

PLC – Programmable Logic Controller

RPM – Revolutions per Minute

SCR – Silicon-Controller Rectifier

TB – Terminal Block

UL – Underwriters Laboratory

V – Voltage (Volts)

VAC – Volts Alternating Current

VDC – Volts Direct Current

XFMR – Transformer